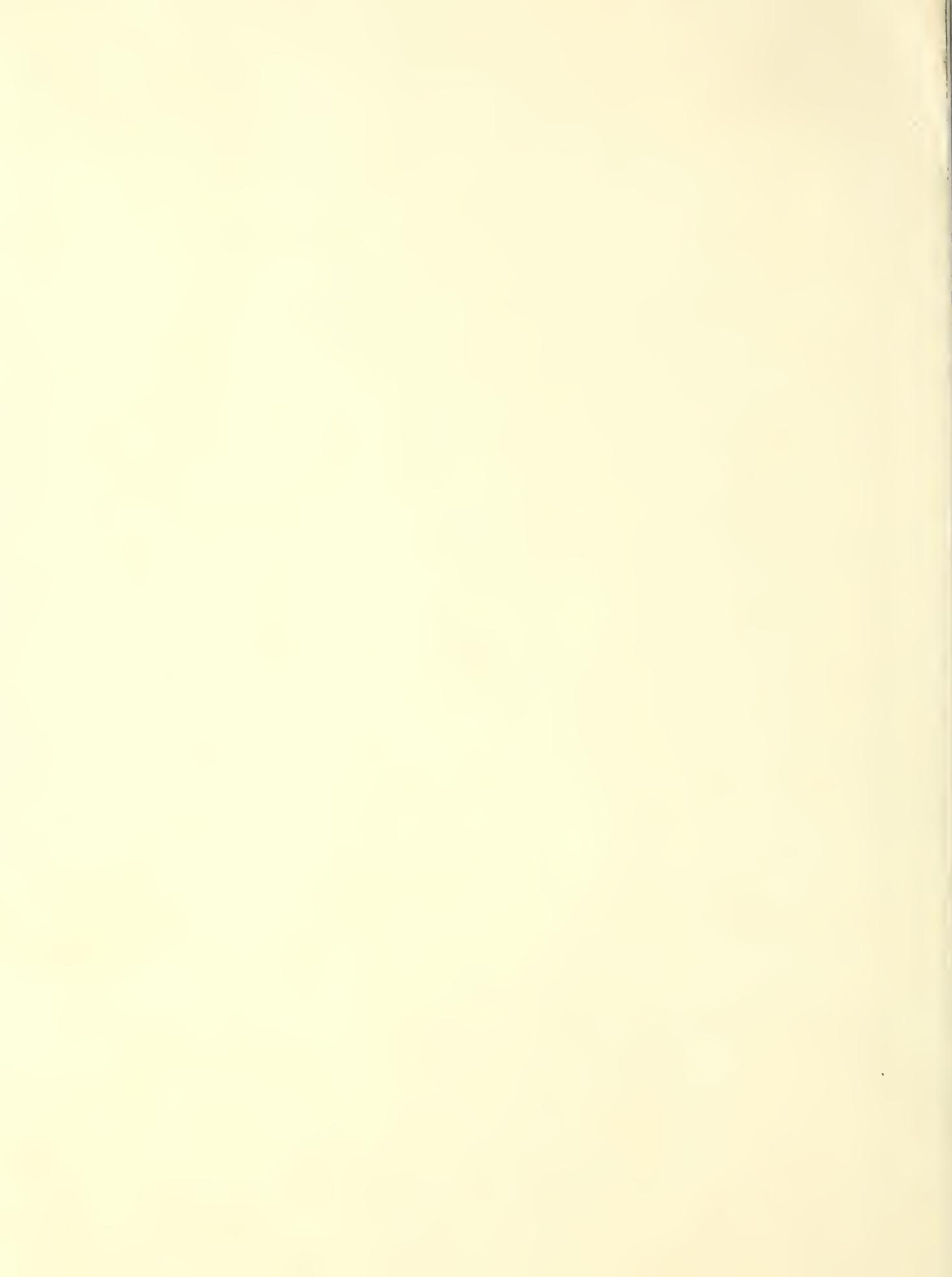


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DEVELOPING AND TESTING NEW FOODS AND FIBERS

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DEVELOPING AND TESTING NEW FOODS AND FIBERS 1/

Supermarkets across the country now stock potato flakes. Today about 10 U.S. companies produce this product, and American production for a recent year was 47 million pounds--worth about \$30 million at retail. Developed at one of the U.S. Department of Agriculture's utilization laboratories, potato flakes were market tested by a market fact-finding team of the Economic Research Service. Tests convinced researchers of a favorable future for flakes and later success in the actual market verified these predictions.

Potato flakes provide a vivid illustration of USDA's new product research in action. Other Department products and processes have been equally successful, but some newly developed items never achieve a place in the market. This article describes research work done at the 4 "labs" and some outstanding achievements.

The Utilization Laboratories

Although USDA has carried on utilization research for nearly a century, it was not until 1938 that work was formalized and coordinated in 4 regional laboratories. Scientists continually describe results, procedures, and work in progress in papers, articles, and books. In addition, about 200 or more patents have been issued to each of the 4 regional labs. These are granted in the name of the inventor but are assigned to the Secretary of Agriculture. Any individual or organization in the U.S. may obtain cost-free licenses to use Department-patented inventions.

Laboratories are located in Peoria, Ill.; New Orleans, La.; Albany, Calif. (near San Francisco); and Philadelphia, Pa. They are called the Northern, South-

ern, Western, and Eastern Regional Research Utilization Laboratories, respectively. As these research organizations grew, field stations were added. For example, the Western Laboratory has field stations in Hawaii, Pasadena, Calif., and in Prosser and Puyallup, Wash. A fifth laboratory is scheduled to be added to the system in Athens, Ga. Each lab has 400 to 500 workers, most of whom are highly trained in the physical sciences.

The labs originally were established to find new ways of utilizing commodities in surplus. The Agricultural Act of 1938 directed that . . . "Research and development shall be devoted to those commodities in which there are regular or seasonal surpluses, and their products and by-products . . ." This work with surplus crops is still a main function, although work has expanded into other areas. During World War II, emphasis was diverted to helping with the war effort; at that time few foods were in surplus. However, the shift to wartime needs did not completely obscure peacetime objectives of the research. For example, work during the emergency was shifted to food preservation, particularly dehydration. Advances made in drying methods became valuable later. Advance of the dehydration industry is in part attributable to the groundwork laid 2 decades ago.

Today's program is broader than that envisioned in the early beginning when work was limited to surplus commodities. Studies now include all farm products. During the late 1950's, pioneering research, long recognized as integral and acutely needed, was initiated as a specific research area. In this research, scientists, relieved from routine assignments, explore the unknown. In the long run, this type of research may shortcut the route to new products.

1/ Prepared by Kermit Bird, agricultural economist, Marketing Economics Division, Economic Research Service, USDA. Free copies of this article are available from: Division of Information, Office of Management Services, U.S. Department of Agriculture, Washington, D.C., 20250.

The present program, in short, has many objectives. One remains constant--that of improving the position of agriculture in the U.S. economy by maintaining and expanding markets for products, by better meeting market requirements, and by satisfying human wants. This is being achieved by developing new foods, new processing methods, new fibers, and through basic research.

New Products and Processes of the Utilization Labs

Each laboratory devotes special attention to a group of regionally grown commodities and products. The Northern Laboratory conducts research on corn, wheat, grain sorghum, other grains, soybeans, flaxseed, other oilseed crops, and new crops. Main emphasis is on finding new and improved industrial uses of agricultural products through chemistry. This lab developed a process for the commercial production of penicillin. It also has done work in other health aids such as Vitamins B₂ and B₁₂ and Dextran, a blood plasma extender.

The Southern Laboratory does work on cotton, plant fibers, seed proteins, sugar-cane, citrus fruits, oilseeds, naval stores, sweetpotatoes, and southern vegetables. Accomplishments include contributions to the development of wash-and-wear and stretch cotton. Its research helped make cotton fibers resistant to heat, rot, and chemicals. Frozen citrus concentrates were another achievement, as were sweet-potato flakes.

In the Western Lab emphasis is on wool and mohair, wheat, barley, rice, forage crops, fruits and vegetables, poultry and eggs, tree nuts, dry beans and peas, castor seed, sugar beets, and various new crops. The Western Lab has worked on food dehydration. In addition, it has made considerable progress in wool research, including intensive studies involving the relations between structural, chemical, and physical properties. Studies of frozen foods include one development that up-grades quality of

frozen foods in storage and transit through work on time-temperature-tolerance. New types of processing equipment and processing methods have also been developed.

The Eastern division, which covers a 14-State area from Maine to Kentucky, is charged with research on animal products, eastern fruits and vegetables, tobacco, honey, maple products, and new crops. The lab has done investigative work with farm fats and oils. Research there has developed a commercial application in which farm fats become a part of animal feeds. More than 1/2 billion pounds annually of farm fats are now being used in this manner. Another application of farm-produced fats has been in plastics. Potato flakes, mentioned earlier, was an innovation developed at this lab. Major work has been done in recovery of flavors and essences. Explosive-puffing methods for drying fruits and vegetables are future potential contributions to food processing.

The Role of Market Research in Testing New Products

The invention of a new product and process does not complete the evolution of new product development. Before the process or product can achieve its desired place in the market, some market testing is usually necessary. USDA market economists work closely with the laboratory scientists. Economists test products and processes and make recommendations as to their acceptability. In addition, they study the market feasibility for new uses of foods, new crops and new processing methods. These studies bear indirectly on the lab program. Sometimes they suggest areas of needed research for technical workers of the labs. Several examples show the type of research that provides commercial firms with marketing data on new developed products or processes.

White Potato Flakes Market Tests

The study of white potato flakes is a good example of retail test marketing.^{2/}

^{2/} Potato Flakes - A New Form of Dehydrated Mashed Potatoes: Market Position and Consumer Acceptance, in Binghamton, Endicott, and Johnson City, N.Y., by Philip Dwoskin and Milton Jacobs, USDA, MRR-186, Wash., D.C.

In 1957, the tri-city area of Binghamton, Endicott, and Johnson City, N.Y., was selected as a test area. First step was to conduct store audits to establish benchmark sales of all closely competing food products prior to the actual market test. Then, all 41 supermarkets and a sample of smaller stores in the area were stocked with potato flakes. Retail prices were set at a level consistent with those of other processed potato products on the market. The Maine Potato Commission financed the promotion campaign. Store audits and a followup consumer survey were used to determine repeat purchase patterns. On the basis of this test and other indicators, several manufacturers went into production and put a commercial product on the market. The successful introduction of flakes validated findings of the market test--that the product did indeed have a favorable sales potential. Other products, when tested, do not always show such favorable results. These may be dropped or returned to the laboratory for improvement.

Successful introduction of a dehydrated potato product and its widespread acceptance in institutional and household markets had a salutary effect on the potato processing industry. It triggered growth of a large number of other forms of dehydrated potatoes and facilitated growth of other processed forms such as frozen potatoes. In 1958, 18 percent of the total U.S. potato crop went into processing; by 1963, the proportion had risen to 29 percent. Ensuing years saw American potato processing develop from 210 million pounds of finished product to the 1 billion pound industry of today. 3/

Sweetpotato Flakes Market Tests

A different type of market research was employed in regard to sweetpotato flakes. Here the institutional market was the object of investigation. A preliminary objective was to determine extent of prior use of sweetpotatoes and information on how they were used. Managers of restaurants and their chefs were asked to try the instant sweetpotato product under controlled research conditions. Researchers determined how well this product fitted into institutional use. This was from both operational and kitchen viewpoints, as well as customer reactions. In the sweetpotato study, a sample of 88 restaurants in New Orleans and Cleveland was used. The product, necessary recipes, and instructions for preparation were provided. Results showed some restaurant managers thought the new instantized sweetpotato product fitted well into their operations. Customers indicated a liking for the product. 4/ A study of households' reactions to flakes revealed a similar pattern of favorable results.5/ To study package needs and future salability of the product, small-scale or micro tests were made in simulated supermarkets. These tests were later followed by an actual sales test in 5 supermarkets. Results showed sweetpotato flakes in glass jars had greater sales appeal than those packed in cans, pouches, or paper cartons. This indicated that good initial sales of sweetpotato flakes in jars could be expected. The initial research program showed the new product appealed to people who were not regular consumers of sweetpotatoes. This conclusion implied that sales of canned

3/ "The Prospective Market for Processed Potatoes," paper presented by Marshall E. Miller to the National Potato Council, Denver, Colo., Nov. 19, 1963. The extraordinary growth of the processed potato industry is described in, Market Potential for Processed Potato Products, by Harry Harp and Denis Dunham, USDA, MRR-505, Oct. 1961, Wash. D.C.

4/ Market Tests of Instant Sweetpotatoes in Selected Institutional Outlets, by Philip B. Dwoskin, O.C. Hester, Howard W. Kerr, and James Bayton, USDA, MRR-580, Jan. 1963, Wash., D.C.

5/ Instant Sweetpotato Flakes, by Dan S. Hollon, USDA, MRR-663, July 1964, Wash. D.C.

and fresh sweetpotatoes would not be lessened by introduction of the new flake product. 6/ Three new plants are now processing sweetpotato flakes for a rapidly growing market.

Dehydrofrozen Apple Market Tests

A third example of market testing research involves a product that is first partly dried and later frozen for storing and shipping. A study of dehydrofrozen apple slices was conducted among bakers during 1960 and 1961. Bakers in Baltimore, Washington, and Philadelphia were given a week's supply of the test product. These bakers then were interviewed to learn of their experiences in preparing and using them in pie baking. Results showed 9 out of 10 pie bakers felt there were advantages in using dehydrofrozen apple slices. Convenience and quality were high on the list. The slices were considered convenient, even though they had to be reconstituted before they were usable in pies. Favorable reactions of bakers cooperating, especially those using large quantities of apple slices, indicated good commercial possibilities for this product. Now 9 companies dehydrofreeze apples for pie baking and other uses. 7/

WURLANized Wool Market Tests

A final example of work carried out under this marketing research program is that currently being done on wool. WURLAN is a process whereby all-wool fabrics are treated to give them more of the desired laundering characteristics. This study was conducted among retail buyers of wool clothes. In total, 40 firms, operating 3,300 retail outlets, were shown samples of WURLANized wool fabrics and similar

samples of untreated wool fabrics. Information obtained concerned sales of presently available machine-washable wool apparel. These retailers described what laundering improvements in wool fabrics they thought were needed. They estimated future sales of wool fabrics if launderability were improved. Retailers said their present machine-washable wool fabrics lacked several characteristics needed for easy laundering and discussed washable wool apparels that had not satisfied market needs. Results showed WURLAN could improve retailers' ability to merchandise many all-wool apparel items. Now introduced into the market, WURLAN gives wool a lasting new market dimension by adding complete launderability to the present desirable properties of natural wool. 8/

These examples of marketing research show how information was gathered from several groups. In the first illustration retail markets and households were investigated. Next, the primary focus was on the institutional outlet. In the study of dehydrofrozen apple slices, bakers were asked to help. In the one concerning WURLANized wool, retail clothing buyers participated. A brief listing of subjects of other studies includes sour cream, cottage cheese, low-fat milk, and both dried and frozen eggs. Other studies have been made of leather, cotton products, frozen bakers items, Kona coffee, freeze-drying, bulgur, dehydrofrozen peas, super-concentrated apple juice, fats and oils, and new crop possibilities.

With a good record for success in predicting acceptability of new products, market potential research is an integral part of the utilization research program. This type of research increases the efficiency of the total laboratory program by

6/ Recent Research on the Market of Sweetpotato Flakes, by Howard W. Kerr, and O.C. Hester, USDA, ERS-194. Reprinted from the Marketing and Transportation Situation, Aug. 1964., Wash. D.C.

7/ Dehydrofrozen Apple Slices: Their Potential in Selected Markets, by Edward J. McGrath, and Howard W. Kerr, USDA, MRR-578, Jan. 1964., Wash., D.C.

8/ "Opportunities for the WURLAN Process in All-Wool Apparel," speech by Larry Clayton to the Technical Wool Conference, San Francisco, Calif., May 13, 1964, Wash., D.C.

some preproduct market studies. By determining whether there is an actual market need, the laboratory scientists are aided in making the best use of their resources.

New Products and Processes

Research with foods, fibers, and other farm products is a continuing process. Some of the newer research of the labs is reported here with no attempt at completeness. Some other new products, not of lab origin, also are reported in the following paragraphs. 9/

Chromatography is a new technique of chemical analysis that makes it now possible to isolate and identify complex chemicals that are flavor components of foods. Using it, the food industry can open the door to secrets of natural flavor. An important benefit will be that food processors may now create and maintain flavor uniformity even though the raw materials were grown, handled, and marketed under a wide variety of conditions.

Enzymes, biochemical catalysts, cause production of specific chemicals necessary in all living matter. They control most life processes. Naturally-occurring enzymes have long been used in processing fruits, making wine and beer, baking bread, and tenderizing meat. As research reveals the nature of how enzymes work, a greater and greater use of them in a wide variety of applications will come. One use of enzymes is in medical diagnosis. Test strips of paper with a small amount of enzyme in it permit a diabetic to test his own sugar level. Housewives have long used natural meat tenderizers, such as papaya juice. A new twist is to treat the cattle with injections of enzymes just prior to slaughter. Not only does this improve good meat, but many lower quality cuts are made more palatable.

Fundemental research on proteins is of far reaching importance. Fabricated protein products, an outgrowth of this new knowledge, are near commercial development stage. Thus far, vegetable proteins isolated from soybeans have been used. Wheat gluten, as demonstrated by the Western Lab, also may be used. The process is to take the protein, put it in fiber form, and spin it into products having the texture of ham, chicken, turkey, etc. Advances in flavor research, combined with the artful use of food-coloring materials, provide an authentic looking, good testing meat substitute.

Atomic radiation is another important basic advance in food processing now approaching an early stage of commercialization. It allows preservation without heat and eventually may mean the consumer will have a food more nearly fresh in terms of color, odor, and flavor. Many problems are still present in spite of recent advances.

Another use of radiation, pasteurization by gamma rays, extends shelf life of foods. This can be of considerable economic importance since food spoilage is costly. Products offering greatest immediate possibilities for shelf-life extension are fish and shellfish.

Nitrogen freezing is a promising low temperature cooling method. Sprayed nitrogen now is used to freeze fruits and vegetables that have not been successfully frozen by the use of present commercial freezing methods. Nitrogen freezing has temperatures ranging downward to minus 320 °F, but it is generally more costly than conventional freezing methods. It requires strict control, particularly regarding the length of freezing time. Minimum time is about 6 minutes for mushrooms. But for some products, such as tomato slices, green beans, melons, mushrooms, strawberries, and seafoods, this freezing method

9/ Examples given in this section describing new products and processes were taken from a speech by Philip Dwoskin entitled "Research for Improved Family Living," presented at the annual meeting of the Nebraska Council of Home Extension Clubs, Columbus, Nebr., Sept. 1964., and Burlington, Vt., Oct. 1964, Wash. D.C.

offers improved quality. At least 6 commercial plants in the U.S. now do nitrogen freezing. The outlook is for many more during the next year or two.

Commercialization on a national scale in the near future is the prospect of some exotic subtropical fruits and vegetables in fresh or processed form. Guacamole is a frozen avocado salad made by an old Mexican recipe. Instant Kona coffee, a gourmet coffee from the Kona coast of the island of Hawaii, is another item. The prospect of being able to buy ripe, high quality Hawaii grown papayas, passion fruit, and pineapples is exciting to those who have tasted these fruits fresh in Hawaii. Jet air-freight and new processing and handling methods may make this possible.

Bulgur, in its dried form, has been well received in foreign countries and seems to be catching on in some parts of this country. Current work aims to make it more convenient. Time required to rewet the dried product is reduced. When puffed like breakfast cereals, this wheat is easily reconstituted.

Chemical peeling plus mechanical agitation have been successfully applied to wheat. This process innovation retains most of the nutritive outer layer on wheat grain, yet removes colored bran layers. Left is a white grain with a pleasant flavor. Export and domestic market possibilities could be good for this new product.

Explosion puffing with blueberries, carrots, beets, and apple slices and pieces indicates interesting market possibilities. This is particularly true at the institutional level. Superheated air is exploded through the partly dried pieces creating a porous structure. This opened structure, plus the fact the material is exposed to heat

for only a short time, provides the basis for high quality. Their use as ingredient items in various dry mixes offers a promising potential.

Fibers research has the potential for improving family living. Natural fibers such as wool and cotton have suffered serious losses in markets to man-made fibers. Aided by some excellent research efforts at the Southern and Western Laboratories, natural fibers are regaining some lost markets for some uses. They are becoming more competitive in certain areas. For example, researcher took the "shrink" out of wool by development of a process that coats the fiber with a film and results in a completely launderable wool garment. Researchers put a permanent wrinkle in cotton fiber to give it stretch. They also provide cotton with a memory so that it may regain its normal shape. Scientists are able to impart a luster to a finished cotton garment that may now enable cotton to invade high fashion markets. Similar work is being done on wool, and results may be equally productive. Of considerable interest at present is a flame-proofing treatment developed for a variety of fabrics. Treated fabric chars but does not burn.

A fire retardant paint is the result of fire-proofing research. A new retardant paint using tung oil appears superior to those firm-resistant paints currently on the market. Important civilian and defense advantages are apparent. In World War II, much of the destruction caused from bombings was due to fires. Developed by the Southern Laboratory, this paint actually retards flame support by producing a thick carbonaceous mass that insulates the coated material from further burning. Successes have been rewarding; and continued efforts, anticipated in the future, will bring forth others. Benefactors have been farmers, marketing agencies of all types, and consumers.

